What is claimed is:

1. A light converging optical system for use in an optical pickup apparatus which conducts reproducing and/or recording information for a first optical information recording medium by converging a light flux with a wavelength of $\lambda 1$ ($350 \text{ nm} \le \lambda 1 \le 450 \text{ nm}$) emitted from a first light source on an information recording surface of a first optical information recording medium having a protective substrate with a thickness of t1 ($0.5 \text{ mm} \le t1 \le 0.7 \text{ mm}$) and conducts reproducing and/or recording information for a second optical information recording medium by converging a light flux with a wavelength of $\lambda 2$ ($650 \text{ nm} \le \lambda 2 \le 700 \text{ nm}$) emitted from a second light source on an information recording surface of a second optical information recording medium having a protective substrate with a thickness of t2 ($0.5 \text{ mm} \le t2 \le 0.7 \text{ mm}$), the light converging optical system comprising:

an objective optical element being a single lens and arranged to face directly the information recording surface of each of the first and second optical information recording media;

a first optical element being a single lens and arranged to face directly a light source side optical surface of the objective optical element; and

a phase difference giving structure formed on at least one optical surface of optical surfaces of the objective optical element and the first optical element and for giving a phase difference to a light flux with a wavelength $\lambda 1$, the phase difference giving structure having a chromatic aberration correcting function for correcting a chromatic aberration in such a way that when the wavelength of a light flux emitted from the first light source varies by 1 nm from $\lambda 1$, the phase difference giving structure corrects a varied aberration quantity at the same position on the optical axis before and after the wavelength variation to 0.03 λrms or less.

2. The light converging optical system of claim 1, wherein at least one optical surface on the first optical element is a convex surface.

3. The light converging optical system of claim 2, wherein both optical surfaces on the first optical element are a convex surface and an aspherical surface.

4. The light converging optical system of claim 2, wherein the light converging optical system has a function to correct a spherical aberration caused by a wavelength difference between a light flux with a wavelength $\lambda 1$ and a light flux with a wavelength $\lambda 2$.

5. The light converging optical system of claim 3, wherein light converging optical system achieves a function to correct a spherical aberration caused by a wavelength difference between a light flux with a wavelength $\lambda 1$ and a light flux with a wavelength $\lambda 2$ by combining a refractive power of an optical surface of the objective optical element and a refractive power of an optical surface of the first optical element.

6. The converging optical system of claim 2, wherein the objective optical element satisfies the following formulas:

$m1 = 0$

$m2 = 0$

where m1 is an optical magnification for a light flux with a wavelength $\lambda1$, and m2 is an optical magnification for a light flux with a wavelength $\lambda2$.

7. The light converging optical system of claim 6, wherein the phase difference giving structure is a diffractive structure and the light converging optical system converges a n-th (n is a natural number) ordered diffracted ray of a light flux with a wavelength $\lambda1$ generated by the diffractive structure onto the information recording surface on the first optical information recording medium.

8. The light converging optical system of claim 7, wherein n is 5 (n=5).

9. The light converging optical system of claim 7, wherein n is 8 (n=8).

10. The light converging optical system of claim 2, wherein the objective optical element satisfies the following formulas:

$m1 = 0$

$m2 \neq 0$

where m1 is an optical magnification for a light flux with a wavelength $\lambda1$, and m2 is an optical magnification for a light flux with a wavelength $\lambda2$.

11. The light converging optical system of claim 10, wherein the phase difference giving structure is a diffractive structure and the light converging optical system converges a n-th (n is a natural number) ordered diffracted ray of a light flux with a wavelength $\lambda1$ generated by the diffractive structure onto the information recording surface on the first optical information recording medium.

12. The light converging optical system of claim 11, wherein the diffraction order n is 5.

13. The light converging optical system of claim 11, wherein the diffraction order n is 8.

14. The light converging optical system of claim 2, wherein a distance on the optical axis from an optical information

recording media side optical surface of the objective optical element to a surface of the protective substrate on the first optical information recording medium is 1 mm or more.

15. The light converging optical system of claim 2, wherein a focal length of a composite system composed of the objective optical lens and the first optical element for a light flux with a wavelength $\lambda 1$ is in the range from 2.0 mm to 4.0 mm.

16. The light converging optical system of claim 2, further comprising an optical element having a chromatic aberration correction function for correcting a chromatic aberration in such a way that when the wavelength of a light flux emitted from the second light source varies by 1 nm from $\lambda 2$, the phase difference giving structure corrects a varied aberration quantity at the same position on the optical axis before and after the wavelength variation to 0.03 λrms or less, wherein the optical element is arranged on an optical path of a light flux with a wavelength of $\lambda 2$ and out of an optical path of a light flux with a wavelength of $\lambda 1$.

17. The light converging optical system of claim 2, wherein the phase difference giving structure comprises a serrated diffractive ring-shaped zones or a stepped structure in which a plurality of ring-shaped zones are formed around the optical axis and neighboring ring-shaped zones of the plurality of ring-shaped zones are jointed through a step almost parallel to the optical axis; and wherein the number of the diffractive ring-shaped zones or the number of the steps in the stepped structure is in a range from 15 to 30.

18. The light converging optical system of claim 2, wherein the objective optical element and the first optical element have different Abbe constants for a light flux with a wavelength of $\lambda 1$.

19. The light converging optical system of claim 2, wherein the objective optical element and the first optical element have the same Abbe constant for a light flux with a wavelength of $\lambda 1$.

20. The light converging optical system of claim 18, wherein a material of at least one of the objective optical element or the first optical element is a plastic material.

21. The light converging optical system of claim 2, wherein a relative position between the objective optical element and the first optical element is changeable when the optical pickup apparatus is driven.

22. The light converging optical system of claim 2, wherein a relative position between the objective optical element and the first optical element is constant when the optical pickup apparatus is driven.

23. The light converging optical system of claim 22, wherein the objective optical element and the first optical element are physically connected to each other.

24. The light converging optical system of claim 21, wherein a distance on the optical axis from a light source side optical surface of the first optical element to an optical information recording medium side optical surface of the objective optical element is 3 mm or less.

25. The light converging optical system of claim 1, wherein the optical pickup apparatus conducts reproducing and/or recording information for a first optical information recording medium by

converging a light flux with a wavelength of $\lambda 3$ (750 nm $\leq \lambda 3 \leq$ 850 nm) emitted from a third light source on an information recording surface of a third optical information recording medium having a protective substrate with a thickness of t3 (1.1 mm $\leq$ t3 $\leq$ 1.3 mm).

26. The light converging optical element of claim 25, wherein the objective optical element satisfies the following formulas:

$$m1 = 0$$

$$m2 = 0$$

$$m3 = 0$$

where m1 is an optical magnification for a light flux with a wavelength $\lambda 1$, m2 is an optical magnification for a light flux with a wavelength $\lambda 2$, and m3 is an optical magnification for a light flux with a wavelength $\lambda 3$.

27. The light converging optical system of claim 26, wherein the phase difference giving structure is a diffractive structure and an optical surface among optical surfaces of the objective optical element and the first optical element on which the phase difference giving structure is formed is divided into at least a central area including the optical axis and a peripheral area enclosing the circumference of the central area such that only a light flux with a wavelength of $\lambda 3$ having passed through the central area is used for reproducing and/or recording information on the third information recording medium, and

wherein the central area is divided into at least a first area and a second area, and the first area and the second area respectively have a diffractive structure in at least a part thereof such that when a light flux with a wavelength of $\lambda 1$ is recorded on the information recording surface of the first information recording medium, a n1-th (n1 is a positive odd number) order diffracted light ray caused by a diffractive structure of the first area among a light flux of $\lambda 1$ having passed through the first area is used and a n2-th (n2 is a positive even number) order diffracted light ray caused by a diffractive structure of the second

area among a light flux of $\lambda2$ having passed through the second area is used.

28. The light converging system of claim 27, wherein the first and second areas are jointed through a stepped surface located along the optical axis.

29. The light converging optical system of claim 28, wherein the first area and the second area are formed by only one on the center area respectively.

30. The light converging optical system of claim 29, wherein the first area is formed in an area including the optical axis.

31. The light converging optical system of claim 29, wherein the second area is formed in an area including the optical axis.

32. The light converging optical system of claim 25, wherein the objective optical element satisfies the following formulas:

$m1 = 0$

$m2 = 0$

$m3 \neq 0$

where m1 is an optical magnification for a light flux with a wavelength $\lambda1$, m2 is an optical magnification for a light flux with a wavelength $\lambda2$, and m3 is an optical magnification for a light flux with a wavelength $\lambda3$.

33. The light converging optical system of claim 32, wherein the phase difference giving structure is a diffractive structure and an optical surface among optical surfaces of the objective optical element and the first optical element on which the phase difference giving structure is formed is divided into at least a central area including the optical axis and a peripheral area enclosing the circumference of the central area such that a light flux with a wavelength of $\lambda3$ having passed through the central area is used for reproducing and/or recording information on the third information recording medium and a light flux with a wavelength of $\lambda3$ having passed through the peripheral area is not used for reproducing and/or recording information on the third information recording medium, and

wherein the central area has the diffractive structure in at least a part thereof such that when a light flux with a wavelength of λ1 is recorded on the information recording surface of the first information recording medium, a n3-th (n3 is a positive even number) order diffracted light caused by the diffractive structure among a light flux of λ1 having passed through the central area is used.

34. The light converging optical system of claim 33, wherein a diffraction order of a light flux with a wavelength of λ1 having passed through the central area is 10, 8, 6, or 2.

35. The light converging optical system of claim 33, wherein the peripheral area has the diffractive structure in at least part thereof such that when a light flux with a wavelength of λ1 is recorded on the information recording surface of the first information recording medium, a n4-th (n4 is a positive odd number) order diffracted light ray caused by the diffractive structure among a light flux of λ1 having passed through the peripheral area is used.

36. The light converging optical system of claim 33, wherein a light flux with a wavelength of $\lambda 3$ having passed through the peripheral area is given a phase difference by the phase difference giving structure to become flare so that the light flux with a wavelength of $\lambda 3$ is not converged on the information recording surface on the third information recording medium.

37. The light converging optical system of claim 33, wherein an optical element having an aperture limiting function not to converge a light flux with a wavelength of $\lambda 3$ passing through the peripheral area onto the third optical information recording medium, is arranged opposite to an light source side optical surface of the first optical element.

38. The light converging optical system of claim 33, wherein a multi-layered film with wavelength selectivity is applied on at least one optical surface among optical surfaces of the objective optical element and the first optical element and the wavelength selectivity of the multi-layered film allows a light flux with a wavelength of $\lambda 1$ and

a light flux with a wavelength of λ2 to pass through and reflects a light flux with a wavelength of λ3 so as not to converge onto a information recording surface of the third optical information recording medium.

39. The light converging optical system of claim 33, wherein the optical pickup apparatus comprises a hologram-equipped laser unit in which an optical detector and the second light source are incorporated in one body, and a light flux with a wavelength of λ2 is reflected on the information recoding surface of the second information recording medium, proceeds on a homeward optical path to a hologram element in the hologram-equipped laser unit along the same optical path on the outward optical path, is changed the proceeding direction by the hologram element and enters an optical detector.

40. The light converging optical system of claim 25, wherein the objective optical element satisfies the following formulas:

$$m1 = 0$$

$$m2 \neq 0$$

$m3 \neq 0$

where m1 is an optical magnification for a light flux with a wavelength $\lambda 1$, m2 is an optical magnification for a light flux with a wavelength $\lambda 2$, and m3 is an optical magnification for a light flux with a wavelength $\lambda 3$.

41. The light converging optical system of claim 40, which the following formula is satisfied:

$m2 = m3$.

42. The light converging optical system of claim 41, wherein the second and third optical sources are united into one element.

43. The light converging optical system of claim 40, wherein the optical pickup apparatus comprises a hologram-equipped laser unit in which an optical detector and the third light source are incorporated in one body, and a light flux with a wavelength of $\lambda 3$ is reflected on the information recoding surface of the third information recording medium, proceeds on a homeward optical path to a hologram element in the hologram-equipped laser unit along the same optical path

on the outward optical path, is changed the proceeding direction by the hologram element and enters an optical detector.

44. The light converging optical system of claim 40, which the light converging optical system is used in an optical pickup apparatus which enables to reproduce and/or record information on the first optical information medium having a protective substrate with a thickness of t1, a first information recording surface and a second information recording surface which are laminated in this order from the light source side along the optical axis.

45. The light converging optical system of claim 25, wherein a distance on the optical axis from an optical information recording media side optical surface of the objective optical element to a surface of the protective substrate on the first optical information recording medium is 1 mm or more.

46. The light converging optical system of claim 25, wherein a focal length of a composite system composed of the objective optical lens and the first optical element for a

light flux with a wavelength of $\lambda 1$ is in the range from 2.0 mm to 4.0 mm.

47. The light converging optical system of claim 25, further comprising an optical element having a chromatic aberration correction function for correcting chromatic aberration in such a way that when the wavelength of a light flux emitted from the second light source varies by 1 nm from $\lambda 2$, the phase difference giving structure corrects a varied aberration quantity at the same position on the optical axis before and after the wavelength variation to 0.03 λrms or less and the optical element is arranged on an optical path of a light flux with a wavelength of $\lambda 2$ and out of an optical path of a light flux with a wavelength of $\lambda 1$.

48. The light converging optical system of claim 25, wherein the phase difference giving structure comprises a serrated diffractive ring-shaped zones or a stepped structure in which a plurality of ring-shaped zones are formed around the optical axis and neighboring ring-shaped zones of the plurality of ring-shaped zones are jointed through a step almost parallel to the optical axis, and wherein the number

of the diffractive ring-shaped zones or the number of the steps in the stepped structure is in a range from 15 to 30.

49. The light converging optical system of claim 25, wherein the objective optical element and the first optical element have different Abbe constants for a light flux with a wavelength of $\lambda 1$.

50. The light converging optical system of claim 25, wherein the objective optical element and the first optical element have the same Abbe constant for a light flux with a wavelength of $\lambda 1$.

51. The light converging optical system of claim 49, wherein a material of at least one of the objective optical element or the first optical element is a plastic material.

52. The light converging optical system of claim 25, wherein a relative position between the objective optical element and the first optical element is changeable when the optical pickup apparatus is driven.

53. The light converging optical system of claim 25, wherein a relative position between the objective optical element and the first optical element is not adapted to be changeable when the optical pickup apparatus is driven.

54. The light converging optical system of claim 53, wherein the objective optical element and the first optical element are physically connected to each other.

55. The light converging optical system of claim 53, wherein a distance on the optical axis from a light source side optical surface of the first optical element to an optical information recording medium side optical surface of the objective optical element is 3 mm or less.

56. The light converging optical system of claim 1, wherein the phase difference giving structure is a diffractive structure which converges a n-th (n is a natural number of 4 or more) order diffracted light flux ray caused by the diffractive structure onto the information recording surface on the first optical information recording medium.

57. The light converging optical system of claim 56, wherein the diffraction order n is from 5 to 10.

58. The light converging optical system of claim 57, wherein the diffraction order n is 5 or 8.

59. The light converging optical system of claim 58, wherein the diffraction order n is 5.

60. The light converging optical system of claim 58, wherein the diffraction order n is 8.